What is claimed is:

1. A spatial motion recognition system, comprising:

a motion detection unit for outputting position changes of a body of the system in space as an electric signal based on three-dimensional motions of the system body; and

a control unit for tracking three-dimensional motions of the system body based on the electric signal outputted from the motion detection unit, producing a virtual handwriting plane having the shortest distances with respect to respective positions in predetermined time intervals based on three-dimensional track information obtained through tracking, and projecting the respective positions in the predetermined time intervals onto the virtual handwriting plane to recover the motions in space.

2. The spatial motion recognition system as claimed in claim 1, wherein the control unit calculates the virtual handwriting plane having the shortest distances with respect to positions in the predetermined time intervals, using the following equation:

$$\begin{bmatrix} \sum_{i=1}^{m} x_i^2 & \sum_{i=1}^{m} x_i y_i & \sum_{i=1}^{m} x_i \\ \sum_{i=1}^{m} x_i y_i & \sum_{i=1}^{m} y_i^2 & \sum_{i=1}^{m} y_i \\ \sum_{i=1}^{m} x_i & \sum_{i=1}^{m} y_i & m \end{bmatrix} \begin{bmatrix} \alpha \\ \beta \\ \gamma \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{m} z_i x_i \\ \sum_{i=1}^{m} y_i z_i \\ \sum_{i=1}^{m} z_i \end{bmatrix}$$

wherein (x_i, y_i, z_i) are coordinates of the system body that is tracked at a predetermined time in three-dimensional space, and α, β, and γ are parameters for the virtual handwriting plane.

3. The spatial motion recognition system as claimed in claim 1, wherein the control unit calculates tracks of the positions in the predetermined time intervals that are projected onto the virtual handwriting plane by the following equation:

$$x_i' = x_i - \frac{a(ax_i + by_i + cz_i + d)}{a^2 + b^2 + c^2}$$
$$y_i' = y_i - \frac{b(ax_i + bx_i + cz_i + d)}{a^2 + b^2 + c^2}$$
$$z_i' = z_i - \frac{c(ax_i + bx_i + cz_i + d)}{a^2 + b^2 + c^2}$$

wherein (x_i, y_i, z_i) are three-dimensional coordinates when the electric signal obtained based on motion occurrences of the system body in the three-dimensional space is divided in the predetermined time intervals, (x_i', y_i', z_i') are coordinates obtained when an arbitrary position of (x_i, y_i, z_i) in the predetermined time intervals are projected onto the virtual handwriting plane, and a, b, c, and d are parameters for the virtual handwriting plane.

4. The spatial motion recognition system as claimed in claim 1, wherein the control unit rotation-converts the tracks of the virtual handwriting plane into a two-dimensional plane of x and y axes in order to reproduce the tracks projected onto the virtual handwriting plane on the two-dimensional plane.

5. The spatial motion recognition system as claimed in claim 4, wherein the control unit calculates the rotation-converted tracks by the following equation:

$$\begin{bmatrix} x_i'' \\ y_i'' \\ z_i'' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & -\sin\phi \\ 0 & \sin\phi & \cos\phi \end{bmatrix} \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix} \begin{bmatrix} x_i' \\ y_i' \\ z_i' \end{bmatrix}$$
$$\phi = \arctan 2(-b, -c)$$
$$\theta = \arctan 2(a, \sqrt{b^2 + c^2})$$

wherein (x_i', y_i', z_i') are three-dimensional coordinates when the tracks are segmented in the predetermined time intervals and then the i^{th} position of (x_i, y_i, z_i) is projected on the virtual handwriting plane, and (x_i'', y_i'', z_i'') are coordinates of a point obtained when the i^{th} position of the projected tracks is rotated by θ degrees about the y axis and rotated by ϕ degrees about the x axis.

6. A spatial motion recognition method for a motion recognition system, comprising:

obtaining three-dimensional track information on a system body in space;

producing a virtual handwriting plane having the shortest distances with respect to respective positions in predetermined time intervals based on the obtained three-dimensional track information; and

projecting the positions in the predetermined time intervals onto the virtual handwriting plane and recovering the motions in space.

7. The spatial motion recognition method as claimed in claim 6, wherein the virtual handwriting plane is calculated by the following equation:

$$\begin{bmatrix} \sum_{i=1}^{m} x_i^2 & \sum_{i=1}^{m} x_i y_i & \sum_{i=1}^{m} x_i \\ \sum_{i=1}^{m} x_i y_i & \sum_{i=1}^{m} y_i^2 & \sum_{i=1}^{m} y_i \\ \sum_{i=1}^{m} x_i & \sum_{i=1}^{m} y_i & m \end{bmatrix} \begin{bmatrix} \alpha \\ \beta \\ \gamma \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{m} z_i x_i \\ \sum_{i=1}^{m} y_i z_i \\ \sum_{i=1}^{m} z_i \end{bmatrix}$$

wherein (x_i, y_i, z_i)are coordinates of the system body that is tracked at a predetermined time in the three-dimensional space, and α, β, and γ are parameters for the virtual handwriting plane.

8. The spatial motion recognition method as claimed in claim 6, wherein the positions in the predetermined time intervals that are projected onto the virtual handwriting plane are calculated by the following equation:

$$x_i' = x_i - \frac{a(ax_i + by_i + cz_i + d)}{a^2 + b^2 + c^2}$$
$$y_i' = y_i - \frac{b(ax_i + bx_i + cz_i + d)}{a^2 + b^2 + c^2}$$
$$z_i' = z_i - \frac{c(ax_i + bx_i + cz_i + d)}{a^2 + b^2 + c^2}$$

wherein (x_i, y_i, z_i)are three-dimensional coordinates at a predetermined time tracked based on motion occurrences of the system body in the three-dimensional space, (x_i', y_i', zi')are coordinates obtained when an arbitrary position of (x_i, y_i, z_i) is projected onto the virtual handwriting plane, and a, b, c, and d are parameters for the virtual handwriting plane.

9. The spatial motion recognition method as claimed in claim 6, further comprising rotation-converting the tracks of the virtual handwriting plane into a two-dimensional plane of x and y axes in order to reproduce the tracks projected onto the virtual handwriting plane on the two-dimensional plane.

10. The spatial motion recognition method as claimed in claim 9, wherein the rotation-converted tracks are calculated by the following equation:

$$\begin{bmatrix} x_i'' \\ y_i'' \\ z_i'' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & -\sin\phi \\ 0 & \sin\phi & \cos\phi \end{bmatrix} \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix} \begin{bmatrix} x_i' \\ y_i' \\ z_i' \end{bmatrix}$$
$$\phi = \arctan 2(-b, -c)$$
$$\theta = \arctan 2(a, \sqrt{b^2 + c^2})$$

wherein (x_i', y_i', z_i')are three-dimensional coordinates when the tracks are segmented in the predetermined time intervals and then the i^{th} position of (x_i, y_i, z_i) is projected on the virtual handwriting plane, and (x_i", y_i", z_i")are coordinates of a point obtained when the i^{th} position of the projected tracks is rotated by θ degrees about the y axis and rotated by ϕ degrees about the x axis.